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AUTHOR Campbell, Frances A.; Ramey, Craig T.
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ABSTRACT

This paper describes long-term intellectual and academic outcomes of the Carolina Abecedarian Project, a study of the effects of intensive early intervention for children of poverty-level families. Participants in the program were 59 girls and 52 boys nominated by local social welfare departments and prenatal clinics. At or prior to birth, children were assigned to either the Child Development Center Intervention group or the preschool control group. Before entry into kindergarten, children were assigned to either a school-age intervention group or to a school-age control group. This allowed a comparison of children who had eight years of intervention (five in preschool and three in early elementary school), five years of preschool intervention only, three years of school-age intervention only, or no educational intervention. A follow-up at age 12 showed that positive effects of preschool treatment on children's intellectual test performance and on academic tests of reading and mathematics were maintained into early adolescence. A second follow-up at age 15 revealed that academic performance was significantly enhanced in reading and mathematics for children who had intervention from infancy to age 5. Results suggest that childcare in high quality settings was associated with significantly enhanced academic performance through middle adolescence. (MM)

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# Mid-Adolescent Outcomes for High Risk Students: An Examination of the Continuing Effects of Early Intervention

Frances A. Campbell
Frank Porter Graham Child Development Center
University of North Carolina at Chapel Hill
Chapel Hill, NC

Craig T. Ramey
Civitan International Research Center
University of Alabama at Birmingham
Birmingham, AL

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# Mid-Adolescent Outcomes for High-Risk Students: An Examination of the Continuing Effects of Early Intervention

## Introduction

The purpose of this study is to examine the long-term intellectual and academic outcomes of one of the most intensive early intervention programs ever provided for children of poverty-level families. It addresses the following questions:

1. Were there different patterns of intellectual development from infancy through mid-adolescence for children who had educational intervention in early childhood compared with untreated controls?

2. Where there detectable effects of early childhood educational intervention in the academic test scores of treated individuals at age 15, seven years after all intervention ended?

3. Where there differences in school progress (indexed by retention in grade or use of Special Education) as a function of early intervention?

4. Which phase of intervention had the stronger effect - preschool or school-age?

## Background of ABC Study

Intergenerational poverty is a stubborn problem. Individuals whose parents had earnings within the bottom quintal are themselves likely to have earnings within the bottom quintal (Hill & Duncan, 1987). Early academic failure has been implicated in the poverty cycle. Zigler, Abelson, Trickett and Seitz (1982) argued that early academic problems set up a self-fulfilling prophecy of failure within children because negative experiences in the primary grades lead to discouragement and alienation from school. Thus, despite universal free education, many persons born into poverty remain trapped there.

Moreover, in our society the problem of poverty is confounded by race. Early discouragement in educational settings appears to be an especially serious problem for African American children. Despite beginning first grade at levels approximately equal to those of majority race children, African American children fall behind others almost

immediately (Alexander & Entwisle, 1988). In her book Children of Color, Jewell Gibbs noted that, in 1980, nearly one quarter of African Americans aged 18-21 had not completed high school but were out of school (Gibbs, 1989). In some areas, the school dropout rate for African Americans is as high as 40 to 60%.

It seems logical that educational intervention provided during the preschool years might prevent academic failure in children at risk; it should lead to early school success, creating a base of confidence upon which later success can be built. Thus, early educational intervention for children of low-income families has been a major focus of public policy in this country for 30 years. Such programs have focused their efforts on cognitive development "because of the concern about school failure and the realization that cognitive processing will have a great deal to do with vocational success" (Gallagher, 1991, p. 432). Accordingly, evaluators of such programs generally use standardized cognitive tests to measure their success. Most investigators found that, when their intervention programs ended, treated children outperformed untreated controls on standardized tests. However, when long-term results from these programs began to be known, there was considerable disappointment over the short duration of their direct effects on the IQ levels and scholastic performance of treated children.

A meta-analysis of the outcomes for Project Head Start showed that by the end of the second year in public school, educationally meaningful differences between program participants and control children were no longer apparent (McKay, Condelli, Ganson, Barrett, McConkey, & Plantz, 1975). The Consortium for Longitudinal Studies (Lazar, Darlington, Murray, Royce, & Snipper, 1982) followed up children from 11 different early educational programs and found significantly less likelihood of retention in grade or placement in special classes for children who had early treatment. However, they also found that IQ gains were no longer apparent after about three years in public school and treatment/control difference on academic measures had eroded by five or six years in school.

Admittedly Head Start was initially provided as a limited summer program, and even expanded, typically was provided to children for only one year, at age 4 years. Similarly, most of the programs included in the Consortium for Longitudinal studies were provided for children aged two or older, many for children aged 4 or older. There was thus a need to learn how much the development of children from economically impoverished backgrounds might be enhanced by a more intensive intervention that began as early as possible in the life span.

Psychology as a science has been dominated by a necessity to discover "laws" of human behavior based on acceptable experimental evidence. Such evidence is not easy to obtain, however, since there are stringent ethical restrictions on the degree to which human lives are amenable to scientific scrutiny and experimental manipulation. Experimental studies of basic developmental processes, especially those where environments might be altered in major ways, have been largely limited to animal research. A second major source of theory in developmental psychology has been clinical work, especially that of Freud and other psychoanalytic investigators. Clinical evidence from the study of infants deprived of normal rearing environments (Spitz, 1945, 1946) or of infants provided with extra stimulation within institutions (Skeels, 1939, 1966) led to important insights concerning environmental factors necessary for normal social-emotional and cognitive development. Other important evidence about the effects of the early environment came from biologists carrying out ethological research on the long lasting effects of early experience (e.g. Lorenz, 1965) and psychologists who showed that the cell structure of the brain was altered by environmental deprivation or enrichment (Hebb, 1949). Together, these lines of evidence suggested that early experience largely determined the whole course of later life events. The general principal thus derived was known as the Primacy of Early Experience (Kessen, 1979).

Two theorists were especially influential in applying this principle to intellectual development, and thereby providing a theoretical basis for early educational intervention.

J. McVicker Hunt (1961) in Intelligence and Experience argued that successful intellectual development depended upon the child's exposure to increasingly complex stimuli in developmentally appropriate contexts. Benjamin Bloom in Stability and Change in Human Characteristics (1964) postulated that intellectual growth tapered off after the first four years, thus, by the time children were old enough to enter public school, it was too late to intervene; intellectual development was malleable only during the first few years of life.

The Carolina Abecedarian Project

Grounded in the theory of the Primacy of Early Experience, a multidisciplinary prospective longitudinal study was designed to test the degree to which enrichment of the early environment might positively alter the course of intellectual development and reduce academic failure in children born into poverty families. The first scientific team included a Developmental Psychologist, Dr. Craig Ramey, as the Principal Investigator, an Educational Psychologist, Dr. Joseph Sparling, and two pediatricians, Drs. Albert Collier and Frank Loda, Jr.. The original grant submitted to the National Institutes of Health and Human Development described the work as an effort

> to examine the development of behavior within an intervention program for infants designed to prevent the progressive developmental retardation frequently associated with rural poverty. The intervention program consists of an evolving individualized, theoretically-based curriculum which will be evaluated for its effectiveness, within a multidisciplinary framework.

To accomplish these aims, the following goals were set (Ramey, 1992):

1. Identify children thought to be at risk for suboptimal intellectual development and academic failure, if reared in their natural ecology.

2. Form two equivalent groups of children through random assignment to treatment and non-treatment groups.

3. Institute systematic educational intervention beginning in early infancy.

4. Document differences in rearing conditions during a significant developmental period, beginning at birth.

5. Conduct periodic evaluations of intellectual status and academic performance of treated and non-treated children to determine what differences exist relative to national norms and to local comparison groups.

## Method

### Design

Figure 1 gives the model of the study. The design was as 2 x 2 factorial, with preschool and school-age intervention being the factors. Another way to describe the design is that of a randomized cross-over, with half the preschool treatment group and half the preschool controls having school-age treatment for the first three years in elementary school.

Four cohorts of subjects were admitted to the project between 1972 and 1977. Children were randomly assigned to treatment groups at or even prior to birth. The basis for creating equivalent groups was a High Risk Index derived from a combination of family demographic characteristics and psychological risk factors (Ramey & Smith, 1977). Within each cohort of subjects, pairs of children were assigned one to the Child Development Center Intervention group (E) and one to the preschool Control group (C). Before entry to public school kindergarten, the preschool E and C groups were re-randomized by equating pairs of children within groups on the basis of their Stanford-Binet IQ scores at 48 months, and then assigning one of each pair to a school-age intervention group and the other to a school-age control group. The resulting 4-cell design permitted a comparison of outcomes in children who had a total of 8 years of intervention, 5 in preschool and 3 in early elementary school (EE), 5 years of intervention in preschool only (EC), 3 years of school-age intervention only (CE), and no educational intervention at all (CC).

Subjects

Subjects were nominated for the study by local social welfare departments and prenatal clinics. If families expressed interest in participating, they were visited by project staff who further explained the program to them and scored a High Risk Index to assess their suitability for inclusion in the sample. Mothers who qualified at this level visited the Center where the Wechsler Adult Intelligence Scale (Wechsler, 1955) or the Wechsler Intelligence Scale for Children (Wechsler, 1949) was administered to them. Final eligibility for enrollment was determined after this second interview and testing had been completed. In addition, to be included in the study, infants had to be full-term and apparently healthy at birth. Those with genetic or physical conditions associated with mental retardation, such as Down's Syndrome, or those with physical handicaps, were ineligible. Note that ethnic identification had nothing to do with the selection criteria. However, as it developed, 98% of the families ultimately enrolled in the study were African American.

One-hundred twenty-two families were nominated by local agencies. Of these, only one declined to consider enrollment; a second potential subject miscarried her baby and was not included in the research. The other 120 families agreed to participate, but 8 (7 E, 1 C) subsequently did not, once they learned their random assignments. One child proved to be biologically handicapped and was thus ineligible. In addition, 2 children randomly assigned to the C group were admitted to the daycare program at the urging of local authorities, also rendering them ineligible for the study. Table 1 gives family characteristics of the base sample, excluding the ineligible children. The 111 subjects included 59 females and 52 males, of whom 57 (55 families) were assigned to the E group and 54 (54 families) to the C group.

Abecedarian Treatment

Preschool program. The preschool intervention consisted of an educational daycare program provided for treated children, beginning in early infancy and extending five years

until they "graduated" to public school kindergarten. The program, housed within the Frank Porter Graham Child Development Center, operated full days, year-round.

Infants began attending during the first half of their first year - mean age at entry was 4.4 months. The caregiver to infant ratio was 1:3. An infant curriculum designed by Sparling and Lewis (1979) was used with items assigned to each infant based on the judgement of caregivers and the curriculum staff of the baby's readiness for the activities.

As children grew older, they moved into toddler and preschool classrooms with caregiver:infant ratios gradually increasing to 1:6 by age four. The center's early childhood program resembled that of other high quality preschools, with interest centers for housekeeping, pretend play, fine motor development, and language and literacy learning.

Special emphasis was placed on language development and pre-literacy skills. Caregivers and teachers were given intensive in-service training in ways to foster sociolinguistic competence in the children. The program focused on pragmatic features of language rather than syntax. In addition, pre-phonics training was instituted to prepare children for reading.

As children neared the age for graduation into public kindergarten, a special transition classroom was set up for six weeks in the summer. Community children were also enrolled in this class to provide a larger group size and more heterogeneous socioeconomic mixture, thus increasing the contextual similarity to public kindergarten.

School-age program. The school-age program was designed to increase parental involvement in the child's primary grade educational experience in a number of ways. Parents were encouraged to become active participants in the child's learning through the provision of special activities designed to reinforce at home the basic concepts being learned at school. These activities were contained in curriculum packets customized for each child by Home/School Resource Teachers (HSTs), based on information supplied by the classroom teacher about the concepts currently being covered in class. Classroom teachers also identified skill areas where the child needed extra practice.

Home/School Resource Teachers provided a liaison between home and school. They advocated for the schools within the family and for the child and family within the school. The schools attended by the target children mostly enrolled children from relatively well educated and affluent homes. In this context, teachers sometimes displayed insensitivity to the problems faced by impoverished families. Similarly, low-income or under-educated families were sometimes distrustful of teacher's motives when concerns about children's learning styles or classroom adjustment were raised. The HST was often able to facilitate communication and mutual understanding between parents and teachers.

The HST also helped families with problems non-school-related problems that might compromise the parent's ability to support the child's learning. For example, HSTs might help families to secure better housing, explore employment opportunities, enroll in adult education programs, find childcare for younger children, get to medical appointments, and the like. This supportive service enabled several parents to make positive adjustments in their own lives.

Early outcomes. Attrition during the preschool and early school years was not a serious problem. If attrition is counted by determining the numbers of children who received sufficient exposure to the planned treatment to be counted as treated, 93 children may be so assigned. Attrition thus consists of 18 of 111 children. At the treatment endpoint, IQ test scores are available for 90 of the 93 and academic test scores for 88.

The treatment endpoint for preschool came at kindergarten entry; for children treated in the school-age phase, it came after three years in school had elapsed. At that point, children were approximately eight years old and had completed second grade, if they were on grade level. At this endpoint, significant effects of preschool treatment were found for intellectual test scores across the developmental course from infancy to age eight. At that time also, children treated in preschool scored significantly higher on standardized tests of academic achievement in reading and mathematics whether these were on age-referenced scores of tests individually administered by project staff or on grade-referenced

scores on standardized tests group-administered by the schools at the end of second grade (Ramey & Campbell, 1991). There was also a significantly reduced likelihood that the child treated in preschool would have repeated a grade during the first three years in elementary school (Horacek, Ramey, Campbell, Huffmann, & Fletcher, 1987). It was clear that preschool treatment, as opposed to school-age treatment, had the stronger effect on these positive outcomes.

The Age-15 Follow-up Study

A follow-up at age 12, after seven years in public school and four years after any treatment had been provided, showed that positive effects of preschool treatment on children's intellectual test performance and on academic tests of reading and mathematics had been maintained into early adolescence (Campbell & Ramey, 1993). This represented a longer maintenance of gains from preschool intervention than had typically been found. A second follow-up was then carried out to see if gains were maintained through 10 years in school.

Attrition to age 15. Attrition through age 15 is again counted as the number of subjects who may be fairly assigned to their proper treatment cell through age eight. Of the 93 subjects who qualify, all were located and 92 agreed to take part in the age-15 follow-up. In addition, all 12 of the 18 subjects earlier lost to attrition who were still living and eligible for the follow-up were evaluated at age 15. Four subjects are not living and two were ineligible for being followed up. (None of these six is represented in the earlier results past age five.)

Local population sample. For each Abecedarian adolescent still attending the local school system where most matriculated, a local same-age-or-grade/same-sex peer was picked at random from the school roll and invited to take part in the study. These individuals and their parents took the same test battery as the Abecedarian subjects. Their data give perspective on the level of performance of the Abecedarian subjects within the

local context, and also inform our conclusions about the various predictors of outcomes in the Abecedarian population.

Follow-up Procedures

The data to be presented here were collected from the Abecedarian and LPS subjects during the summer after their tenth year in school. Those on grade level would just have completed ninth grade, the first year of senior high school.

Subjects were tested at the Child Development Center by individuals "blind" with respect to their early intervention history or Abecedarian/LPS group membership. As a part of the follow-up, each adolescent also had a neurodevelopmental examination by a physician at the Clinical Center for the Study of Development and Learning at the University of North Carolina Medical School. The doctors were also "blind" with respect to status or intervention history of the adolescent being evaluated. Parents were interviewed and Language Arts teachers were asked to complete ratings on each adolescent. All data are complete with the exception of teacher data. The fact that a number of ABC students live away from the immediate area and attend school in other districts renders full collection of teacher data infeasible.

Because the procedures were extensive, and also to convey to the subjects the degree to which their participation was valued, the adolescent subjects were reimbursed for the time involved in the follow-up study.

Outcome Measures

The amount of information accumulated on each child in this follow-up study is enormous; this presentation is limited to three major classes of information: intellectual development, academic achievement, and school progress.

Intellectual. The Wechsler Intelligence Scale for Children-Revised (Wechsler, 1974) was used to test the intellectual development of these subjects at age 15. This instrument had also been administered to Abecedarian subjects at age 6.5, 8, and 12 years. The outcomes are presented graphically in Figure 2. WISC-R scores are Full Scale IQs.

Data are also presented for earlier testing occasions back through age three. At 36 and 48 months, IQs from the Stanford-Binet Intelligence Scale (Terman & Merrill, 1972) are given. At 42, 54, and 84 months the General Cognitive Index from the McCarthy Scales of Children's Abilities (McCarthy, 1972) is graphed.

Academic. The Woodcock-Johnson Psycho-Educational Battery, Part 2: Tests of Academic Achievement (Woodcock & Johnson, 1977) is used to measure scholastic attainment from the treatment endpoint through early and mid-adolescence. For each academic subject measured by the test, scores on two or more subtests are combined to create a cluster score for that subject. Cluster scores in turn are compared with the "average cluster score" of the normative sample at a given age or grade level; it is upon the deviation of the individual's cluster score from the normative cluster that age- or grade-referenced percentiles or Standard Scores (with a mean of 100 and S. D. = 15) are derived. In this study, we analyzed age-referenced Standard Scores for Reading and Mathematics across the four treatment groups.

The reading cluster for the Woodcock-Johnson is based on subtests labelled Letter-Word Identification, Word Attack, and Passage Comprehension. A median reliability of .96 was reported for the Reading cluster based on reliability studies conducted across the range of its intended use (Woodcock, 1978).

The Mathematics cluster consists of a combination of the Calculation and Applied Problems subtests - the two aspects of mathematics ability most frequently measured in mathematics achievement tests. A median reliability of .92 was found for this cluster in the reliability studies conducted across the range of intended use (Woodcock, 1978).

## Results

### Demographic

Table 2 gives a summary of the living circumstances of the subjects at age 15, and contrasts their family situations at that age with those seen at earlier points. There was a marked shift in living circumstances over the first eight years of the subjects lives. Over

half the children were living with their mothers in multigenerational homes at birth, primarily with the grandparents; only about one quarter of them lived with both biological parents in the parent's own home at that point. There is a shift by age eight such that the most typical living circumstance from then on was for children to be living in single parent households headed by their mother. The percent of children living with grandparents rather than with parents was small, but stable from age 8 to age 15.

Cognitive and Academic Outcomes

Analytic strategy. General linear models were used to analyze data for the continuous dependent measures such as scores on standardized tests, using repeated measures models as applicable. Age 15 scores were also analyzed in isolation to test the degree of difference maintained to that point. Two models were tested both longitudinally and in isolation: first, the data were tested to see if scores increased as a linear function of the intensity (duration) of treatment, i.e., EE>EC>CE>CC. Next, the 2 (Preschool groups) x 2 (School-age groups) models were tested to see if dependent variables differed as a function of preschool or school-age treatment.

Intellectual outcomes. Figure 2 gives the longitudinal function of IQ scores from age 3 to age 15. Analysis of variance for repeated measures shows a significant main effect for treatment intensity ($F(3,80) = 8.92$, $p < .004$) and also for preschool treatment ($F(3,80) = 14.64$, $p < .0003$). There was a significant main effect for age at testing and the Age x Intensity and Age x Preschool Group interactions were significant ($ps < .05$ or less). If analyzed alone, the age-15 Full Scale WISC-R scores were not significantly different as a function of treatment history. The intensity hypothesis was not confirmed, but the result for preschool group was in the expected direction, $F(1,88) = 3.06$, $p < .08$.

Academic. Of more practical and theoretical importance was the question of the maintenance of positive effects of early intervention on academic performance. Here, benefits of early treatment were more strongly apparent than for IQ test scores. Figure 3 shows age-referenced Standard Scores for the Woodcock-Johnson Reading Cluster at three

ages: 8, 12, and 15 years. Analyzed longitudinally, there were main effects for the intensity hypothesis ($F(1,80) = 10.46, p < .002$), and for preschool group ($F(1,80) = 9.30, p < .003$). There was also a significant change over time described by a "dip" in Standard Score at age 12 and recovery at age 15 for three of four groups ($F(2,79) = 14.14, p < .0001$), but no time x treatment history interactions.

The results for mathematics, graphed in Figure 4, paralleled those for reading: analysis of the Woodcock-Johnson age-referenced Mathematics Standard Scores showed significant main effects for the intensity hypothesis ($F(1,81) = 5.07, p < .03$, and for preschool group ($F(1,81) = 4.75, p < .04$). There was a significant change over time: all groups decreased in age-referenced standard score from age 8 to 12, then scores remained steady ($F(2,80) = 16.94, p < .0001$). There were no time x group interactions.

The age-15 Reading and Mathematics test scores were also analyzed in isolation, first with no covariates, then with child gender, maternal IQ and the quality of the preschool home environment added to the models to increase statistical power. The result was the same either way. Even without the covariates, there was a significant main effect for preschool group. Subjects who had preschool treatment earned significantly higher Reading and Mathematics scores at age 15 ($F(1,88) = 4.22, p < .05$ and $F(1,88) = 4.18$, $p < .05$, respectively).

School progress. As did the Consortium for Longitudinal Studies (Lazar, et al., 1982) we used retention in grade and use of Special Education as indices of school progress. By either standard, the subjects who had the Abecedarian preschool educational experience fared better than preschool Controls through 10 years in school.

Figure 5 gives the percentage of each school-age group ever retained during the first 10 years. A 4 x 2 Chi Square did not attain statistical significance: (Chi Square(3) = 5.19, $p = .16$). However, inspection of the means clearly suggests a difference in retention rate related to preschool group membership, so Chi Square was recalculated using a 2 x 2 model: in that case, Chi $\text{Square}_{(1)} = 5.10, p = .02$.

There are two levels of use of supplemental educational services within the school system: the student might be formally diagnosed as eligible for Special Education services, or might simply be provided with related services which did not require diagnosis and an Individual Education Plan. Assignment to Special Education varied from 12% in the EC group to 47% in the CE and CC groups ((Chi Square$_{(3)}$ = 8.42, $p$=.04); again, a 2 x 2 Chi Square test showed a significant difference related to preschool group (Chi Square$_{(1)}$ = 5.47, $p$=.02).

When the question of use of Special Education and/or any related service was considered, use levels were high for all groups, ranging from 64% in the EE group to 81% in the CE group, and there were not systematic differences in the proportionate rate related to intervention history. Clearly, teachers had made extensive use of supplemental services for these students from low-income families.

## Discussion

Individuals treated in the Abecedarian preschool program show enhanced intellectual development from age 3 to age 15 although treatment/control differences in mental test performance do narrow with increasing age, but not because of a decline in test performance in the treated group. Although a decline occurs between the treatment endpoint at age 8 and age 12 which is virtually the same in all groups irrespective of treatment history, no group declines further after age 12. Rather, the preschool E group stays the same whereas the preschool C group shows a slight increase by age 15. Further analysis of these data is underway in order to understand better the nature of these changes.

Academic performance in reading and mathematics is significantly enhanced through 10 years in public school for children who had intervention from infancy to age 5. Comparing scores within the four school-age groups clearly indicates that the preschool phase of treatment was more strongly associated with the improvement in academic functioning. Having school-age treatment added onto a preschool experience does appear

to have been associated with better maintenance of performance levels in reading, but it did not result in a lasting improvement in reading scores for those students treated only in the primary grades. The slight advantage shown by the CE group in reading scores at the treatment endpoint, age 8, is gone by age 12.

For mathematics, the effect of preschool treatment also remains significant across 10 years of school. However, there appears to be no lasting benefit from the school-age pahse of treatemnt. The test performance of the EE and EC groups is virtually identical at age 12 and age 15 and, to the extent that any enhancement of Woodcock-Johnson mathematics scores was found at age 8 for the CE group, it had disappeared by age 12.

It is difficult to know why the preschool treatment effect is so much stronger than that of the school-age program. One problem in interpreting the outcomes is that the preschool and school-age phases of treatment confound duration of treatment (five years as opposed to three) with period of treatment (infancy through age five compared to age five through age eight). However, the outcomes clearly indicate that for these subjects, the effects of five years of preschool education in a daycare setting were more enduring than the effects of three years of family-mediated intervention during the primary grades.

We might speculate that the better academic performance of the preschool E group is related to the enhancement of IQ levels - that their general intelligence and therefore their ability to learn, was raised. The only other study that provided a similarly intense preschool intervention from infancy through age five, the Milwaukee Project (Garber, 1988), found a greater treatment/control IQ difference at age 14 than was found for the Abecedarian subjects at age 15, but that program could demonstrate no academic advantage for treated subjects after seven years in public school (Garber, Personal communication, June 8, 1992). Differences in the later school settings for graduates of the Abecedarian and Milwaukee programs - a small university town compared to an urban ghetto - may have contributed to the longer lasting maintenance of early academic benefits

in the ABC subjects. It would be unrealistic to expect that any amount of early education could overcome strongly negative influences in an adolescent's concurrent school context.

It is remarkable that effects of preschool treatment on actual academic performance were still apparent in mid-adolescence, in any learning environment. Of other major early education programs that have reported long-term academic test outcomes, only the Perry Preschool Project reported a comparable finding in mid-adolescence. Although its investigators did not find treatment/control differences in academic test performance at earlier ages, the treatment/control groups of the Perry Preschool Project differed significantly at age 14 on academic tests (Schweinhart & Weikart, 1980). In contrast to the pattern of differences for the Perry Preschool study, however, the ABC treatment/control differences in academic performance were significant across every grade level tested.

Consistent with the finding from the Consortium for Longitudinal Studies (Lazar, et al., 1982) students with Abecedarian preschool intervention were more likely to be on grade level at age 15 and not to have been assigned to receive Special Education services. Woodhead (1988) has speculated that, even in the absence of enduring IQ or achievement test differences, early intervention may somehow change the psychosocial functioning of treated children, leading teachers to perceive them in more positive ways and thereby allowing such children to escape being labelled as failures who need to repeat grades or be assigned to special classes. Our data imply that having preschool intervention may have had such an effect. Nothing suggests, however, that having the school-age intervention contributed to such an outcome.

Policy implications. The Carolina Abecedarian Project represents the longest period of continuous early educational intervention ever provided for children of low-income families. The results suggest that childcare in high quality settings is associated with significantly enhanced academic performance through middle adolescence. This underscores the need to provide excellent early environments for infants, toddlers, and preschoolers, whether at home or in other caregiving settings. High quality may well be the

key. The Abecedarian program had a low caregiver:child ratio and staff worked intensely and intentionally with each child to assure that the child benefitted from the program. The Abecedarian program is reproducible in other settings, but quality control would be important. The child's early environment does have an important impact on future academic accomplishments.

The value of providing a follow-through into public school is less clear. By itself, school-age treatment was not associated with greatly enhanced outcomes. Even though it is easier to provide supplemental services for children once they are in school, those who plan interventions should be aware that school-age interventions may have less impact than would programs provided earlier in the life span.

Table 1

Entry Level Demographic Data for Preschool Experimental and Control Families

| | Variable | Group: Experimental (N=55) | Group: Control (N=54) | Total (N=109) |
|---|---|---|---|---|
| 1. | Mean High Risk Index | 20.08 (5.72)* | 21.14 (5.88) | 20.75 (5.81) |
| 2. | Mean Maternal Age (yrs) | 19.56 (3.88) | 20.28 (5.77) | 19.94 (4.89) |
| 3. | Mean Maternal Education (yrs) | 10.45 (1.75) | 10.00 (1.89) | 10.23 (1.83) |
| 4. | Mean Maternal Full Scale IQ | 85.49 (12.43) | 84.18 (10.78) | 84.84 (11.61) |
| 5. | Percent female-headed family | 78% | 65% | 72% |
| 6. | Percent African American | 96% | 100% | 98% |

* Figures in parentheses are Standard Deviations

Table 2

Living Circumstance of Abecedarian Subjects at Three Ages with Local Population Sample Contrast at Age 15

| Family Type | Age | | | |
|---|---|---|---|---|
| | Birth[a] % | 8 Years % | 15 Years % | Age 15 LPS[b] % |
| Complex Multigeneration | 58.2 | 5.4 | 12.8 | 2.1 |
| Two-Parent Family (Intact & Step) | 25.4 | 28.2 | 29.1 | 60.4 |
| Single Parent (Mother or Father) | 10.0 | 35.4 | 33.6 | 35.4 |
| Grandparent(s) Alone | 0 | 6.4 | 7.3 | 0 |

[a] N = 110 Subjects
Sibling family enters twice

[b] N = 48

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## Figure Caption

Figure 1. Study Design of Carolina Abecedarian Project

Figure 2. Age in Months and Cognitive Test

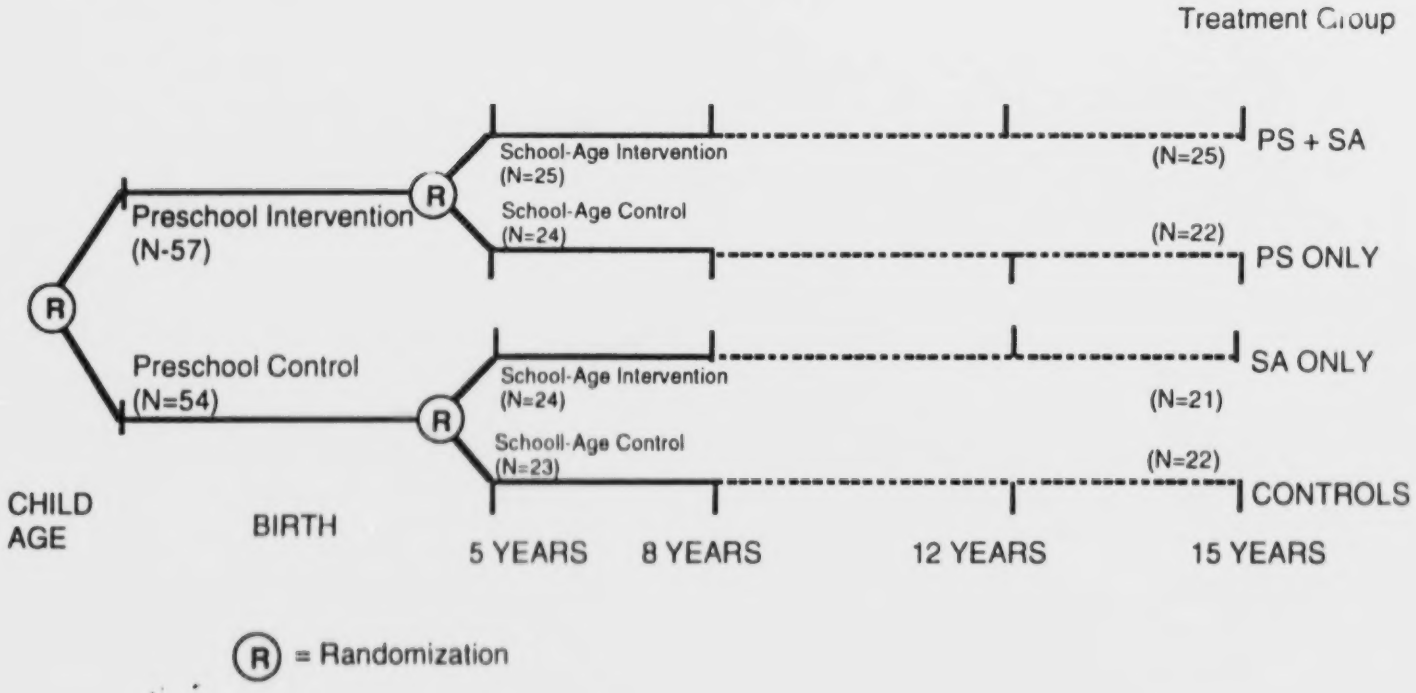
Figure 3. Woodcock-Johnson Standardized Reading Score

Figure 4. Woodcock-Johnson Standardized Math Score

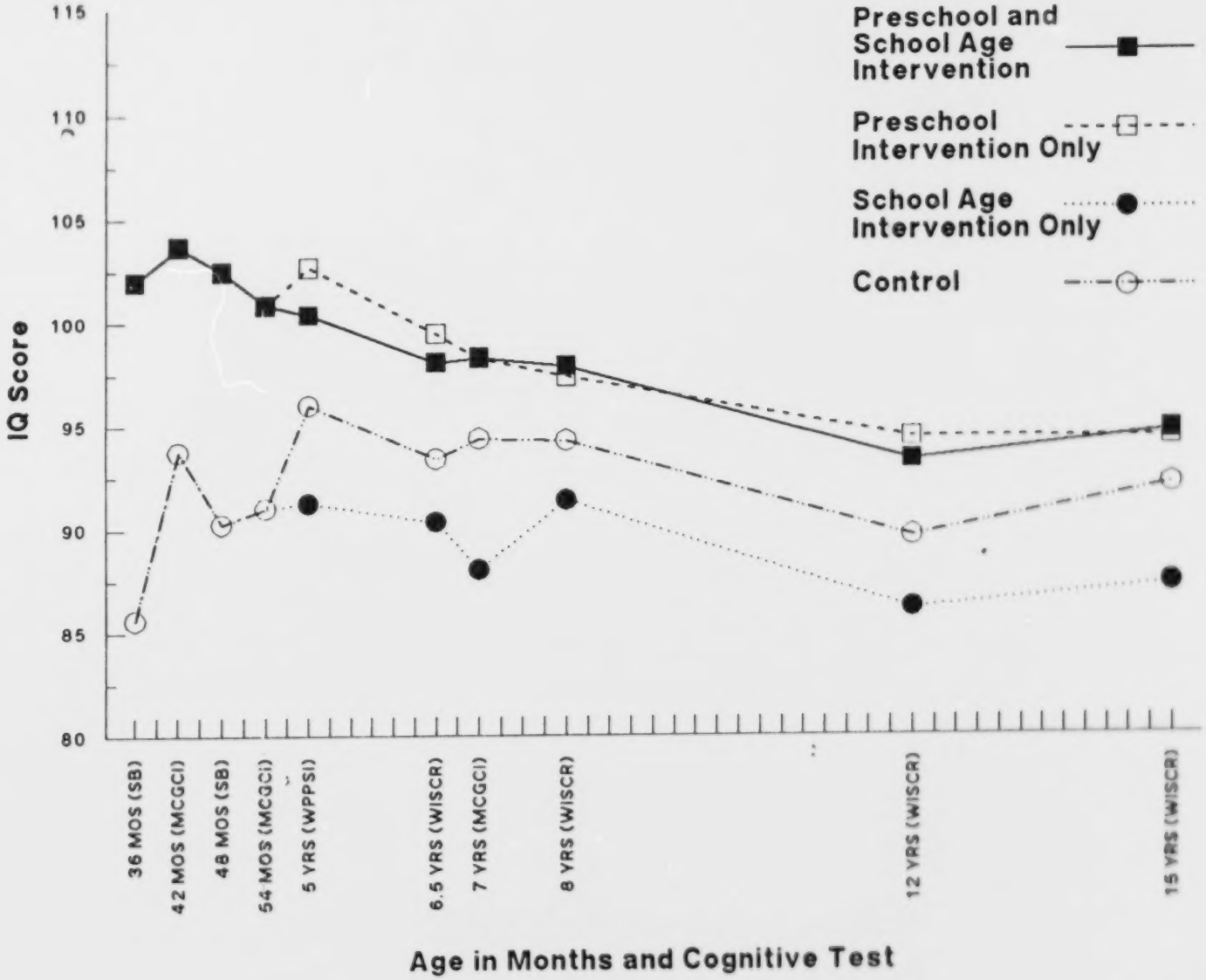
Figure 5. Percentages of Abecedarian Subjects Ever Retained up to age 15

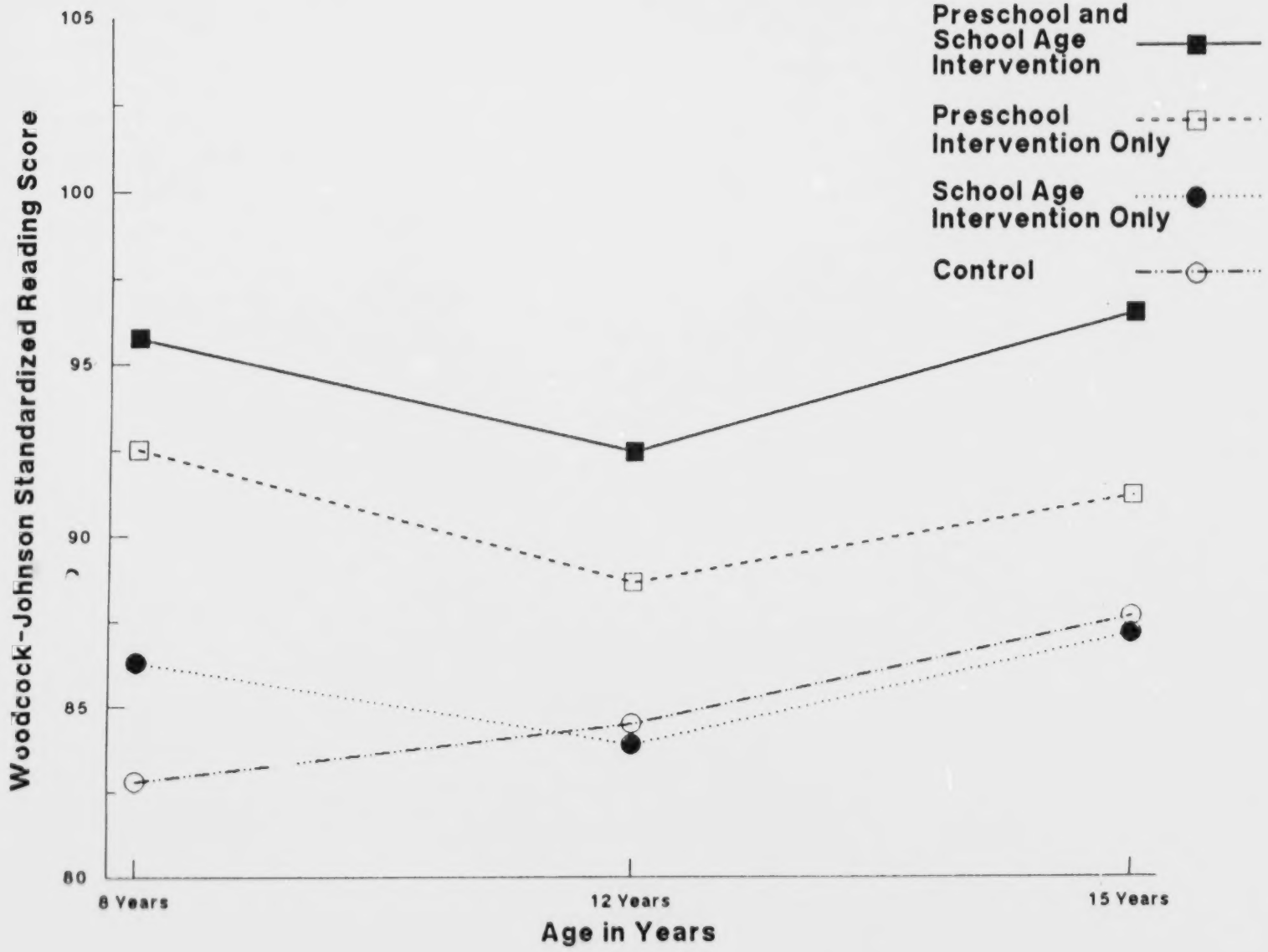
Figure 6. Percentages of Abecedarian Treatment Groups Assigned to Special Services, Grades K-9

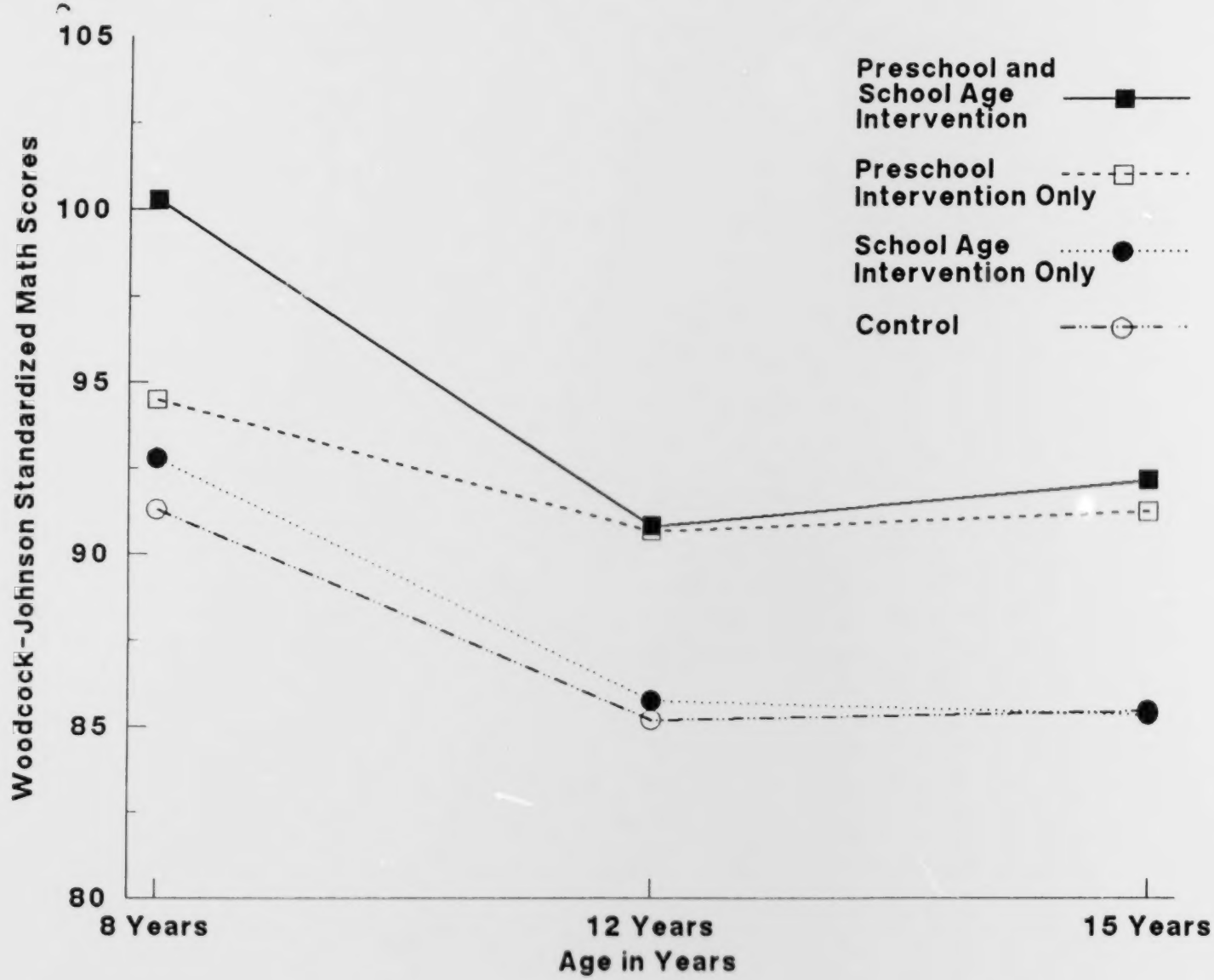
# Study Design of Carolina Abecedarian Project



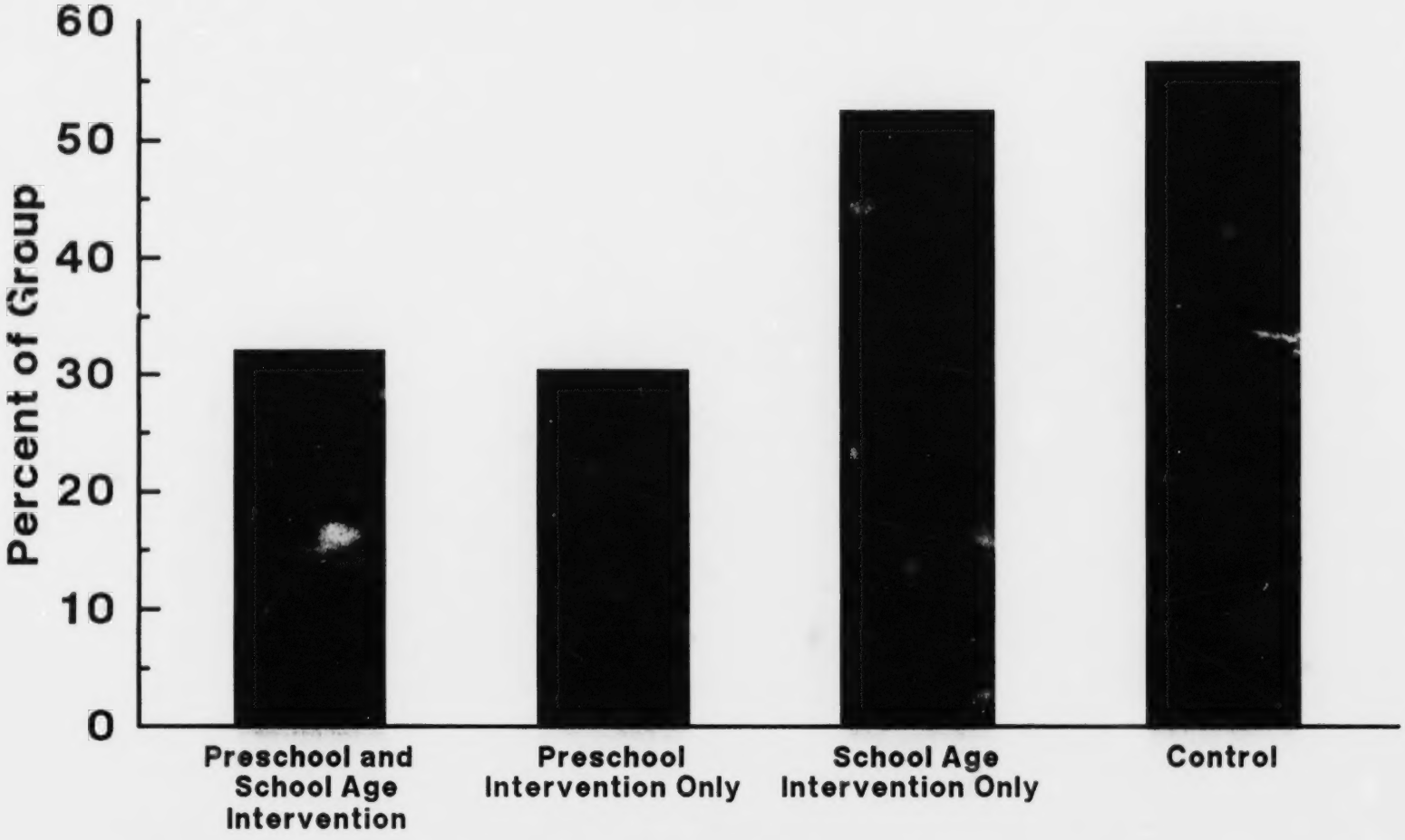

R = Randomization


Preschool and School Age Intervention
Preschool Intervention Only
School Age Intervention Only
Control
IQ Score
115
110
105
100
95
90
85
80
36 MOS (SB)
42 MOS (MCGCI)
48 MOS (SB)
54 MOS (MCGCI)
5 YRS (WPPSI)
6.5 YRS (WISCR)
7 YRS (MCGCI)
8 YRS (WISCR)
12 YRS (WISCR)
15 YRS (WISCR)
Age in Months and Cognitive Test


Preschool and School Age Intervention
Preschool Intervention Only
School Age Intervention Only
Control
Woodcock-Johnson Standardized Reading Score
105
100
95
90
85
80
8 Years
12 Years
15 Years
Age in Years

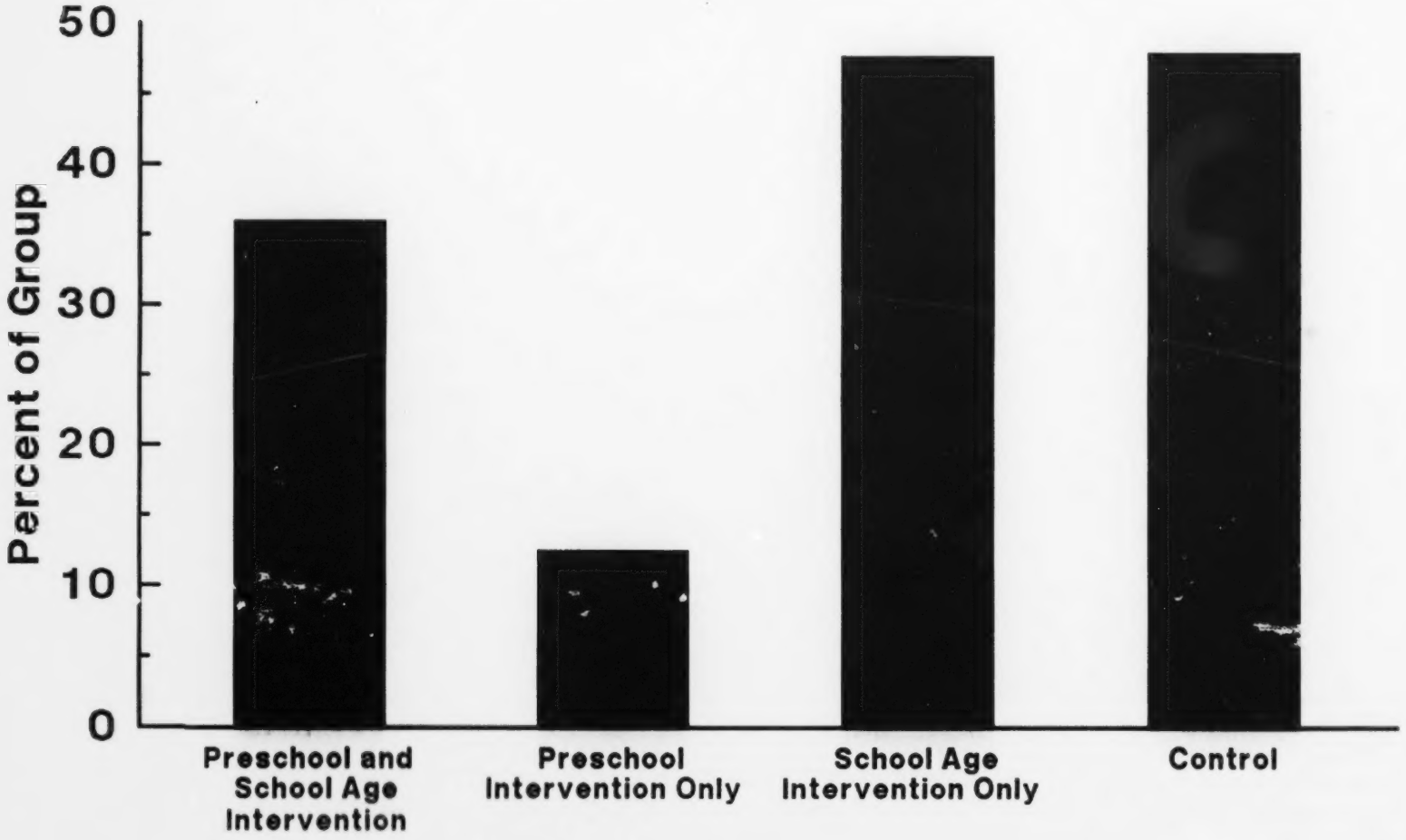

105
100
95
90
85
80
Woodcock-Johnson Standardized Math Scores
Preschool and School Age Intervention
Preschool Intervention Only
School Age Intervention Only
Control
8 Years
12 Years
15 Years
Age in Years

## Percentages of Abecedarian Subjects Ever Retained up to Age 15




Chi-square(df=1) = 5.10, p < .02

## Percentages of Abecedarian Treatment Groups Assigned to Special Services, Grades K-9




Chi-square(df=3) = 8.42, p < .04